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# The impact of an intact infrapatellar fat pad on outcomes after total knee arthroplasty

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# The impact of an intact infrapatellar fat pad on outcomes after total knee arthroplasty

**Abstract**

**Background**. The infrapatellar fat pad (IPFP) is currently resected in approximately 88% of Total Knee Arthroplasties (TKAs). We hypothesised that an intact IPFP would improve outcomes after TKA. **Methods.** Patients with an intact IPFP participated in this cross-sectional study by completing two surveys, at 6 and 12 months after TKA. Both surveys included questions regarding kneeling, with the Oxford Knee Score also included at 12 months. **Results.** Sixty patients participated in this study. At 6 and 12 months, a similar number of patients were able to kneel, 40 (66.7%) and 43 (71.7%), respectively. Fifteen (25.0%) patients were unable to kneel due to knee pain at 6 months; of these, nine (15%) were unable to kneel at 12 months. Moreover, at 12 months, 90.0% of the patients reported minimal or no knee pain. There was no correlation between the inability to kneel and knee pain. There was a significant correlation between the inability to kneel and reduced overall standardised knee function scores. **Conclusions**. This was the first study to demonstrate improved kneeling and descending of stairs after TKA with IPFP preservation. These results in the context of current literature show that IPFP preservation reduces the incidence of knee pain 12 months after TKA.

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*Research Article*

# The Impact of an Intact Infrapatellar Fat Pad on Outcomes after Total Knee Arthroplasty

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*Background*. The infrapatellar fat pad (IPFP) is currently resected in approximately 88% of Total Knee Arthroplasties (TKAs). We hypothesised that an intact IPFP would improve outcomes after TKA. *Methods*. Patients with an intact IPFP participated in this cross-sectional study by completing two surveys, at 6 and 12 months after TKA. Both surveys included questions regarding kneeling, with the Oxford Knee Score also included at 12 months. *Results*. Sixty patients participated in this study. At 6 and 12 months, a similar number of patients were able to kneel, 40 (66.7%) and 43 (71.7%), respectively. Fifteen (25.0%) patients were unable to kneel due to knee pain at 6 months; of these, nine (15%) were unable to kneel at 12 months. Moreover, at 12 months, 90.0% of the patients reported minimal or no knee pain. There was no correlation between the inability to kneel and knee pain ($p = 0.13$). There was a significant correlation between the inability to kneel and reduced overall standardised knee function scores ($p = 0.02$). *Conclusions*. This was the first study to demonstrate improved kneeling and descending of stairs after TKA with IPFP preservation. These results in the context of current literature show that IPFP preservation reduces the incidence of knee pain 12 months after TKA.

## 1. Introduction

The strongest predictor of osteoarthritis (OA) is increasing age; thus with increasing life expectancy there is an increasing incidence of OA [1]. One of the most common joints to be effected by OA is the knee, which inevitably leads to severe pain and immobility [1]. Total Knee Arthroplasty (TKA) is proven to be a cost-effective treatment for end-stage degenerative joint disorders including OA [2]. Each year the number of TKAs being performed continues to increase globally [3], predominately due to an increasing incidence of knee OA [1, 4–6].

Overall patient satisfaction with their TKA is very high, with as many as 81–89% of patients reporting that they are satisfied with their procedure [7–9]. Areas of highest satisfaction, among patients receiving TKAs, include improved knee stability, reduced pain after long periods of sitting, and the ability to complete basic activities of daily living, inclusive of bathing [7–10]. Despite the high level of patient satisfaction, there are also areas of patient dissatisfaction which need to be considered. The most common reasons for patient dissatisfaction include pain resulting from the procedure, an inability to kneel, and trouble descending stairs following the procedure [9]. Given that the number of patients undergoing TKA is increasing, it is important to explore strategies which could be used to improve patient satisfaction in these areas [8, 9]. One such strategy, currently being investigated, is to keep the infrapatellar fat pad (IPFP) intact during routine TKA. To date, there is a paucity of evidence regarding the post-TKA outcomes when the IPFP has not been removed during the procedure [11].

The IPFP has been traditionally removed in order to enhance surgical access during TKA [12]. Over the past few decades, some of the equipment required to perform a TKA has evolved and changed significantly, such as the tibial alignment guides. These guides have become much smaller and subsequently can be used without the need to resect and remove the IPFP for surgical access. However, even with the improvement and the reduction in size of these alignment guides, current literature indicates that the IPFP is still being partially or completely removed in up to 88% of TKAs [9].

Emerging evidence suggests that the IPFP may play an important role in reducing postoperative anterior knee pain

Table 1: The Oxford Knee Score [28, 29].

| Question number | Question |
|---|---|
| 1 | Describe the pain you usually have from your knee? (Pain) |
| 2 | How much trouble do you have washing and drying yourself (all over) because of your knee (Function) |
| 3 | How much trouble do you have getting in/out of your car or using public transport because of your knee? (Function) |
| 4 | For how long have you been able to walk before pain from your knee becomes severe? (with or without a stick) (Pain) |
| 5 | After a meal (sat at a table), how painful has it been for you to stand up from a chair because of your knee? (Pain) |
| 6 | Have you been limping when walking, because of your knee? (Function) |
| 7 | Could you kneel down and get up again afterwards? (Function) |
| 8 | Have you been troubled by pain from your knee in bed at night? (Pain) |
| 9 | How much has pain from your knee interfered with your usual work (including housework)? (Pain) |
| 10 | Have you felt that your knee might suddenly "give way" or let you down? (Function) |
| 11 | Could you do household shopping on your own? (Function) |
| 12 | Could you walk down one flight of stairs? (Function) |

following TKA [13–17]. Even though Maculé et al. [18] and Tanaka et al. [19] found that patients with an intact IPFP experienced the same or higher rates of knee pain in the short term (less than six months after TKA), other studies that considered the long-term effects (beyond six months) showed that patients with an intact IPFP experienced less pain than those with an IPFP resection after TKA [12, 19, 20].

In addition to the potential impact of IPFP resection on anterior knee pain after TKA, it may also have an impact on patients' ability to kneel. TKA alone can improve patients' ability to kneel, from approximately 2–4% prior to the procedure [21, 22] to between 41 and 73% following the procedure [9, 23–26]. Notably, however, some of these patients will experience some degree of difficulty with kneeling following the procedure [21, 23, 25]. This level of difficulty is important, because kneeling is a function that many people require in order to successfully perform everyday tasks, such as professional duties (e.g., carpet laying and plumbing) and recreational activities (e.g., gardening and playing lawn bowls) [21]. The ability to kneel holds an even greater level of importance in middle eastern and far eastern cultures where kneeling is integral to everyday activities, such as praying and sitting for meals [22]. Of all functional outcomes kneeling has been shown to have the least amount of improvement following a TKA [27]. It is therefore surprising that only a small number of studies have looked at kneeling after TKA [22–25] and that no studies have looked at the impact of an intact IPFP on kneeling. The aim of this study was to investigate the impact of an intact IPFP after TKA on knee pain and knee functions, such as the ability to kneel and descend stairs.

## 2. Material and Methods

*2.1. Overview of Study Design.* Following ethics approval from the University of Wollongong human research ethics committee, patients attending an outpatient clinic between July 2013 and May 2014, who did not have their IPFP removed during their routine TKA, were invited to participate in this cross-sectional study. Volunteering patient participants were asked to complete two surveys, which were mailed out to them at 6 and 12 months after TKA. Both surveys included demographic questions and kneeling survey questions, with the addition of the validated Oxford Knee Score [28, 29] in the 12-month survey. These procedures were all performed by the same surgeon at two different hospitals using a cemented, hydroxyapatite-coated posterior cruciate retaining prosthesis incorporated into their tibia. Each knee replacement included patellar resurfacing with a cemented polyethylene button. Surgical access for each operation was gained via a midline incision, with a medial parapatellar approach.

*2.2. Kneeling Survey Questions.* The four questions in both the 6-month and 12-month surveys which focused on kneeling included the following: (1) Are you able to kneel on your replaced knee? (2) Do you have pain with kneeling? (3) Do you have discomfort or increased pressure within the knee with kneeling? (4) Does pain stop/prevent you from kneeling. These questions were scored as yes or no answers and each question was analysed using descriptive statistical analysis.

*2.3. Oxford Knee Score [28, 29].* In addition to the kneeling survey questions discussed above, at twelve months patients were also asked to complete validated and reliable Oxford Knee Score (OKS) [28, 29] as part of their 12-month postprocedure questionnaire. The OKS is a standardised questionnaire consisting of twelve questions, which is used to gauge overall knee pain and knee function after TKA, including the ability to descend stairs and kneel [28, 29] (Table 1).

Patients were asked to base their responses to the OKS on their experiences over the previous four weeks. The possible responses were given a numerical value from zero (worst) to four (best). Overall pain and function scores were calculated based on responses to the OKS [9]. The pain score was calculated by adding together the scores of the five questions related to pain (questions 1, 4, 5, 8, and 9; Table 1), an approach used by Baker et al. [9]. The overall function score was calculated by adding together the scores of the function based questions (questions 2, 3, 6, 7, 10, 11, and 12; Table 1) [9]. The overall pain and function scores were converted to standardised scores to allow for comparison. This was done

Table 2: Results of kneeling survey at 6 and 12 months after Total Knee Arthroplasty.

| | 6 months | | 12 months | |
|---|---|---|---|---|
| | Number of patients ($N = 60$) | % | Number of patients ($N = 60$) | % |
| Are you able to kneel? | 40 | 66.7 | 43 | 71.7 |
| Factors Deterring From Kneeling | | | | |
| Does pain deter you from kneeling? | 25 | 41.7 | 10 | 16.7 |
| Does discomfort or pressure deter you from kneeling? | 22 | 36.7 | 44 | 73.7 |
| Factors Preventing Kneeling | | | | |
| Are you unable to kneel due to knee pain? | 15 | 25.0 | 9 | 15.0 |
| Does discomfort or pressure stop you from kneeling? | 5 | 8.3 | 8 | 13.3 |

by dividing the overall scores by the highest possible score for pain (20) or function (28), a technique used by other researchers in the literature [9]. For example, a pain score of 15 produced a standardised pain score of 0.75 (15/20 = 0.75) and a function score of 14 produced a standardised function score of 0.50 (14/28 = 0.50). The standardised scores were then grouped together to compare the overall pain and function of the patients that could kneel versus those who could not.

*2.4. Statistical Analysis.* The data was analysed using the statistics function of Microsoft Excel 2010. A multivariate logistic regression of the standardised knee pain and knee function scores were conducted to provide comparisons between the group of patients that could kneel and those that could not. A $p$ value $\leq 0.05$ was considered to be statistically significant.

## 3. Results

*3.1. Patient Demographic Data.* Seventy-nine eligible patients were mailed questionnaires at six and twelve months after TKA. Sixty patients returned both questionnaires (32 female, 28 male), indicating a response rate of 75.9%. The mean age of the patients at 6 and 12 months was 67 years.

*3.2. Patient Kneeling Capabilities.* At six months after TKA, 40 of the 60 respondents (66.7%) were able to kneel. Of the 20 patients unable to kneel, 5 (8.3%) reported that this was due to discomfort or knee pressure (Table 2). The remaining 15 (25%) reported that they were unable to kneel due to knee pain (Table 2). Pain was reported as a deterrent factor from kneeling in 41.7% ($n = 25$) of those surveyed (Table 2). Of the 60 respondents surveyed at 12 months after TKA, 43 (71.7%) reported that they were able to kneel. A total of 9 (15%) patients were unable to kneel due to pain, and 8 (13.3%) were unable to kneel due to discomfort and knee pressure (Table 2).

*3.3. Overall Oxford Knee Score Results.* At 12 months after TKA, the average OKS for the 60 patient participants was 42.7/48 (Figure 1). The overall OKS result is a validated indicator of how successful a TKA has been for the patient [28, 29]. The overall OKS can range from zero, which is an extremely poor result, to 48, which represents a knee with perfect function and no pain [28, 29]. In this study, the lowest overall OKS recorded was 13, which means that they scored on average one to two out of four for each question. In contrast, however, 90 percent of patients ($n = 54$) recorded a score of 36 or higher, which indicates that they had minimal to no problems with the TKA [27] (Figure 1).

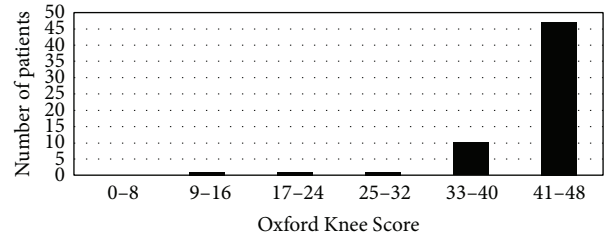


Figure 1: Overall Oxford Knee Score distribution in 60 patients at 12 months after Total Knee Arthroplasty.

Table 3: Frequency (%) of responses to the Oxford Knee Score questions for stair-descending, knee stability, and kneeling ability at 12 months after Total Knee Arthroplasty ($n = 60$).

| | 0 (worst) | 1 | 2 | 3 | 4 (best) |
|---|---|---|---|---|---|
| Ability with stairs | 0 (0.0) | 1 (1.7) | 5 (8.3) | 15 (25.0) | 39 (65.0) |
| Knee stability | 0 (0.0) | 0 (0.0) | 1 (1.7) | 9 (15.0) | 50 (83.3) |
| Kneeling ability | 5 (8.3) | 5 (8.3) | 16 (26.7) | 20 (33.3) | 14 (23.3) |

*3.3.1. Ability to Descend Stairs, Knee Stability, Kneeling, and Overall Knee Function from the OKS.* At 12 months after TKA, the majority of patients reported on the OKS that they were able to descend stairs with minimal to no difficulty (90%), with a mean score of 3.5 out of a possible score of 4 for ability with stairs. Patients had minimal to no problems with their knee stability (3.8/4) and overall knee function (24.8/28). Kneeling was the only question where patients reported mild to moderate difficulty, with a mean score of 2.6 out of 4. The frequency of responses to each of these questions is featured in Table 3.

Table 4: Standardised pain and function scores in patients that could and could not kneel at 12 months after Total Knee Arthroplasty.

| Score* | Overall | | Able to kneel | | Unable to kneel | |
|---|---|---|---|---|---|---|
| | Number | Standardised score (95% CI) | Number | Standardised score (95% CI) | Number | Standardised score (95% CI) |
| Pain | 60 | 0.90 (0.86 to 0.94) | 43 | 0.91 (0.87 to 0.95)[#] | 17 | 0.85 (0.74 to 0.96) |
| Function | 60 | 0.89 (0.86 to 0.92) | 43 | 0.91 (0.88 to 0.94)[¥] | 17 | 0.83 (0.74 to 0.90) |

*Pain is the summation of questions 1, 4, 5, 8, and 9 of the OKS; function is the summation of questions 2, 3, 6, 7, 10, 11, and 12 of the OKS. [#]There was a nonsignificant difference between the pain scores of the patients that could kneel and those that could not ($p = 0.13$). [¥]There was a significant difference in function scores between the group of patients that can kneel and those who cannot ($p = 0.02$).

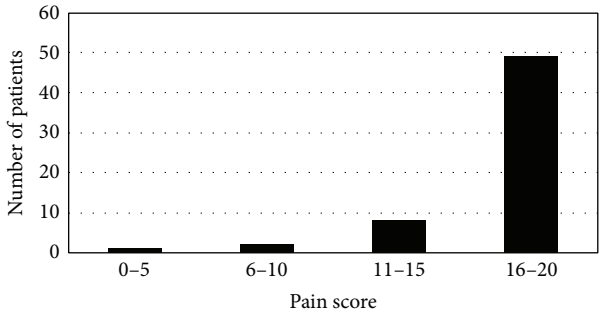


Figure 2: Postoperative pain scores derived from questions 1, 4, 5, 8, and 9 of the Oxford Knee Score at 12 months after Total Knee Arthroplasty ($n = 60$).

*3.3.2. Knee Pain at 12 Months after TKA from the OKS.* The mean pain score derived from the OKS was 17.9/20. Figure 2 shows the pain scores of each patient as calculated from the OKS. The majority of patients (90%) had overall pain scores between 15 and 20, indicating that they experience minimal to no pain at 12 months after TKA. Only six (10%) patients reported their overall knee pain to be in the mild to moderate range (10–14) (Figure 2).

*3.4. Analysis of Ability to Kneel in Relation to Standardised Pain and Function Scores.* The overall group of patients ($n = 60$) had a mean standardised pain score of 0.90 and mean standardised function score of 0.89 (Table 4). There was a significant difference in the standardised function scores between the patients that could kneel (0.91) and those that could not (0.82), as determined by multivariate regression modeling ($p = 0.02$). There was also a difference in the standardised pain score between those who could kneel (0.91) and those who could not (0.85). However, this difference was not significant ($p = 0.13$).

## 4. Discussion

Results of this study showed that a high proportion of patients with an intact IPFP after TKA could kneel at 6 and 12 months following the procedure (66.7% and 71.7%, resp.). At 12 months after TKA, 90.0% of patients reported minimal to no knee pain and that they had minimal to no difficulty descending stairs. Kneeling was the only question where patients reported mild to moderate difficulty (2.6/4). Of comparisons between patients who could and could not kneel at 12 months after TKA, it was found that the inability to kneel was significantly related to knee function ($p = 0.02$) rather than knee pain.

*4.1. Knee Pain.* At 12 months after TKA, 90% of patients reported their knee pain to be mild or nonexistent. The low incidence of knee pain shown in this current study agrees with the results of a number of other studies, which have shown a significant reduction in the incidence of knee pain beyond six months after TKA in patients with an intact IPFP [12, 19, 20]. The incidence of knee pain in the IPFP resection after TKA increased to almost twice that of the preservation group at 5.1 years after procedure [12].

The overall standardised pain score calculated in our study was 0.90 (0.86 to 0.94; 95% CI). Baker et al. (2007) conducted a study of 8,231 patients that had very similar demographics and used an almost identical surgical technique to our study [9]. They found that 84.1% of their patients had either a partial or complete IPFP resection which yielded standardised pain scores of 0.81 (0.81 to 0.82; 95% CI), which was a lower result than our findings. From this comparison of our study with the current literature, it could be proposed that an intact IPFP contributes to reduced medium to long-term knee pain after TKA. One of the most likely explanations may be that the IPFP mediates pain and inflammation while there is an arthritic, inflammatory process occurring in the knee joint [30, 31]. Therefore, once the inflammation in the joint is resolved through TKA, the stimulus for the IPFP to mediate pain and inflammation may no longer be present.

*4.2. Ability to Descend Stairs.* To our knowledge, this was the first study to examine the ability to descend stairs in patients with an intact IPFP after TKA. Hassaballa et al. completed the only previous study to investigate the impact of TKA on the patients' ability to descend stairs [22]. They found that 73.1% of patients were able to descend stairs with minimal or no difficulty at 12 months after TKA; however, their methodology did not disclose the rate of IPFP resections conducted as part of the study [22]. As removal of the IPFP was common practice in the United Kingdom during the time of Hassaballa et al.'s study, it is likely that resection occurred in the majority of these patients [9]. In our study, which looked exclusively at patients with an intact IPFP after TKA, it was found that 90.0% of the patients could descend stairs with minimal to no difficulty at 12 months following their procedure. This is an increase of approximately 17% from Hassaballa et al.'s study, which could suggest that an intact IPFP after TKA increases the patient's ability to descend stairs [22]. One of the reasons we believe that an intact IPFP

may increase the patient's ability to descend stairs is due to the effect that resection has on the patellar tendon. Recent studies have shown that IPFP resection causes shortening of the patellar tendon, which causes a reduction in the range of motion (ROM) in the knee joint [11, 19, 32]. This is important because a reduction in knee ROM impairs patients' ability to descend stairs [33].

*4.3. Ability to Kneel.* Kneeling is a crucial knee function to many people around the world and is currently a functional outcome that shows the least amount of improvement following routine TKA procedures [21, 22, 27]. An important function of the IPFP is to cushion the interface between patellar tendon and the tibial plateau, especially during kneeling [34]. Of the small number of studies that have investigated the impact of TKA on the ability to kneel, only one has explicitly stated the rate of IPFP resection. Baker et al. investigated the ability to kneel in 8,231 patients who had TKA, with 84.1% of these subjects having the IPFP resected [9]. Results of Baker et al.'s study showed that 57% of patients found it extremely difficult to impossible to kneel at 12 months after TKA [9]. In contrast, our study, which exclusively looked at patients with an intact IPFP, found that only 16.6% of patients found it extremely difficult to impossible to kneel at 12 months following the procedure. This suggests that having an intact IPFP may increase the likelihood that a patient can kneel following TKA.

There are commonly a number of reasons why people are unable to kneel after TKA, including pain, skin hypoesthesia, and decreased ROM [22]. In order to gain a better understanding of why the patients in our study were unable to kneel, we divided the results of those that could and could not kneel for further analysis. In these groupings we then compared standardised pain and function scores. Through this analysis we found that those that could kneel had a significantly higher standardised function score ($p = 0.02$) than those who could not. However, we found no significant difference between groups in standardised pain scores ($p = 0.13$). Therefore, these results show that pain is unlikely to be a limiting factor in the ability to kneel in post-TKA patients with an intact IPFP. We believe that the IPFP reduces pain during kneeling as it acts as a cushion which protects the patellar tendon from pressing against the metal tibial plateau prosthesis.

*Limitations.* As this was a pilot study conducted in a limited time frame, several limitations need to be acknowledged. This study did not include a control group, did not look at preoperative scores, only included a small sample size, and only investigated patients treated by one surgeon in two hospitals. A randomised controlled trial (RCT) with preoperative scoring and patients treated by multiple surgeons would have provided much more robust and clinically applicable results. An RCT would have also allowed for a higher level comparison of the impact of an intact versus resected IPFP.

In conclusion, our results in combination with the evidence in the current literature showed that IPFP preservation may lead to more favourable outcomes after TKA in OA patients. We found a correlation between an intact IPFP and reduced rates of knee pain at 12 months after TKA. This is the first study to look at the impact of an intact IPFP on functional outcomes such as kneeling and descending stairs after TKA. The results of this study indicate that an intact IPFP may improve the ability to kneel and descend stairs after TKA. The results of this study are not substantial enough to justify new guidelines to state that the IPFP should be left in situ during TKA. For this reason a well-constructed RCT needs to be conducted.

## Ethical Approval

Authorisation to perform this study was given by a local committee and was performed in accordance with the Ethical Standards of the 1964 Declaration of Helsinki as revised in 2000.

## Consent

All patients gave informed consent prior to enrolling in the study.

## Conflict of Interests

The authors declare that they have no conflict of interests (both personal and financial).

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